Response of Soil Application of Diatomaceous Earth as a Source of Silicon on Leaf Nutrient Status of Guava

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A B S T R A C T

An experiment was carried out in Kittur Rani Channamma College of Horticulture, Arabhavi, Belgaum District, Karnataka state to know the response of soil application of diatomaceous earth (DE) as a source of silicon on leaf nutrient status of guava. Leaf sample under different treatment were collected and utilized for analysis of nutrient status. The highest macronutrient viz., Nitrogen (2.13%), Phosphorous (0.32%) and Potassium (0.65 %) were recorded in plants applied with Half of RDF, Recommended dose of fertilizer (RDF), Half of RDF, RDF + 1kg/plant of DE, and RDF + 3kg/ plant of DE respectively. The Micronutrients of guava leaves viz., Calcium (1.39%), Magnesium (0.44%), Zinc (77.55 ppm), Iron(136.58), Silicon (0.45%), manganese (260.53), and Copper (67.45 ppm) were also recorded in plants applied with RDF + 3kg/plant DE.

Keywords
Diatomaceous Earth (DE), Silicon, Macro nutrient, Micronutrient.

Introduction

The crop production of guava can be increased by balanced nutrition on profitable basis even though it is growing in the tropical condition. The growth, yield and quality of guava can be increased by application of manures and fertilizers as it respond to application of fertilizers. Among the plants, silicon concentration is found to be higher in monocotyledons than in dicotyledons and its level increased from legumes < fruit crops < vegetables < grasses < grain crops. The role of silicon in plant biology is to reduce multiple stresses including biotic and abiotic stresses. It is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity, erectness of leaves and structure of xylem vessels under high transpiration rates (Melo et al., 2003). Silicon application improved water economy and dry matter yield (Gong et al., 2003). It enhanced the leaf water potential under water stress conditions, reduced the incidence of micronutrient and metal toxicity (Matoh et al., 1991). The presence of Silicon also been reported to affect the absorption and translocation of several macro and micro-nutrients. Si is accumulated in plants to total concentrations in dry matter similar to those of essential macro-nutrients such as Potassium, Calcium, Magnesium, Sulphur and
Phosphorous (Epstein, 1999). More recently, silicon amendments were shown to reduce the leaching of phosphate, nitrate and potassium (Matichenkov and Bocharnikova, 2010).

With this brief information and based on the possible benefits of silicon, the present study was carried out to know the Response of Soil Application of Diatomaceous Earth as a Source of Silicon on Leaf Nutrient Status of Guava.

Materials and Methods

Experiment was carried out in an established guava orchard of 6 years old plants with spacing of 6 m x 6 m. The source of silicon used is Diatomaceous earth (DE), applied as basal dose to the respective treatment in this experiment. The dosage of DE used in this experiment was 1, 2 and 3 kg/plant.

The inorganic nutrient i.e. nitrogen was applied in the form of urea (46% N), phosphorous in the form of single super phosphate and potassium in the form of muriate of potash (60% K). These nutrients were applied to the respective treatment according to the package of practice of UHS: Bagalkot (200:80:150 g NPK/plant), (Anon, 2015). The design adopted for the experiment was Randomized Block Design (RBD) with nine treatments and three replications. The treatments are

- T1 - Absolute control,
- T2 - Recommended dose of fertilizer (RDF) @ 200:80:150 g NPK/plant,
- T3 - Half of RDF,
- T4 - Half of RDF + 1kg/plant of Diatomaceous Earth (DE),
- T5 - Half of RDF + 2kg/plant of DE,
- T6 - Half of RDF + 3kg/ plant of DE,
- T7 - RDF + 1kg/plant of DE,
- T8 - RDF + 2kg/plant of DE,
- T9 - RDF + 3kg/ plant of DE

Leaf sampling and processing

Leaf samples were collected from the designated plants of Leaf samples (8th leaf) of each treatment in each replication after 4 months of bahar treatment. After cleaning with distilled water, leaf samples were oven-dried at 50°C till they attain constant weight and analysed for nutrient status. The samples were analysed for total nitrogen, phosphorous, potassium, and micronutrients like, Calcium Magnesium, Zinc, Iron, Silicon, manganese, and Copper content. Estimation of total nitrogen, phosphorous and potassium were analysed as per the procedure given by Jackson, 1967. Calcium and magnesium were analysed as per the procedure given by titration with EDTA (disodium dihydrogenethylene diamine tetraacetate) which was reported by Tucker and Kurtz (1960). Zinc and Copper content was estimated by Diethylene triamine pentaacetic acid (DTPA) method (Lindasay and Norwell, 1978). Silicon content was estimated by ANSA (1-amino-2-naphthol-4-sulfonic acid) method (Kadalli et al., 2013).

Results and Discussion

Effect of different treatments on nutrient content of leaves viz., nitrogen, phosphorus, potassium, calcium, magnesium, zinc, iron and silica are presented in tables 1 and 2. The Nitrogen content in leaf was found non-significant in all the treatments. The higher value recorded in T3 (2.16) and least the value recorded in T6 (2.07). In case of Phosphorus content in leaf was found non-significant. However higher value was recorded in T2, T3, T7 and T9 (0.32) and the least value was recorded in T1 and T6 (0.29%). And also potassium content in guava leaves, there was non-significant difference among the different treatments. The maximum potassium content (0.65 %) was observed in T9 (RDF + 3 kg/plant of DE), While minimum potassium content (0.56 %) was observed in T1.
Table 1 Effect of diatomaceous earth (DE) on macro nutrient content of guava leaf

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N (%)</th>
<th>P (%)</th>
<th>K (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 - Absolute control</td>
<td>2.14</td>
<td>0.29</td>
<td>0.56</td>
</tr>
<tr>
<td>T2 - Recommended dose of fertilizer (RDF)</td>
<td>2.15</td>
<td>0.32</td>
<td>0.60</td>
</tr>
<tr>
<td>T3 - Half of Recommended dose of fertilizer</td>
<td>2.16</td>
<td>0.32</td>
<td>0.60</td>
</tr>
<tr>
<td>T4 - Half of RDF + 1 kg/plant of DE</td>
<td>2.13</td>
<td>0.30</td>
<td>0.63</td>
</tr>
<tr>
<td>T5 - Half of RDF + 2 kg/plant of DE</td>
<td>2.12</td>
<td>0.30</td>
<td>0.62</td>
</tr>
<tr>
<td>T6 - Half of RDF + 3 kg/plant of DE</td>
<td>2.07</td>
<td>0.29</td>
<td>0.61</td>
</tr>
<tr>
<td>T7 - RDF + 1 kg/plant of DE</td>
<td>2.09</td>
<td>0.32</td>
<td>0.61</td>
</tr>
<tr>
<td>T8 - RDF + 2 kg/plant of DE</td>
<td>2.11</td>
<td>0.30</td>
<td>0.54</td>
</tr>
<tr>
<td>T9 - RDF + 3 kg/plant of DE</td>
<td>2.13</td>
<td>0.32</td>
<td>0.65</td>
</tr>
</tbody>
</table>

S.Em±

CD @ 5%  | N.S   | N.S   | N.S   |

N.S- Non significant
### Table 2. Effect of diatomaceous earth (DE) on micro nutrient content of guava leaf

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Ca (%)</th>
<th>Mg (%)</th>
<th>Zn (ppm)</th>
<th>Fe (ppm)</th>
<th>Si (ppm)</th>
<th>Mn (ppm)</th>
<th>Cu (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt; - Absolute control</td>
<td>0.86</td>
<td>0.28</td>
<td>11.31</td>
<td>135.02</td>
<td>0.20</td>
<td>160.31</td>
<td>37.41</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt; - Recommended dose of fertilizer (RDF)</td>
<td>0.94</td>
<td>0.31</td>
<td>11.81</td>
<td>117.53</td>
<td>0.22</td>
<td>181.63</td>
<td>30.73</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt; - Half of Recommended dose of fertilizer</td>
<td>1.00</td>
<td>0.35</td>
<td>14.20</td>
<td>137.38</td>
<td>0.23</td>
<td>172.18</td>
<td>48.20</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt; - Half of RDF + 1kg/plant of DE</td>
<td>1.10</td>
<td>0.37</td>
<td>12.83</td>
<td>134.78</td>
<td>0.32</td>
<td>221.38</td>
<td>65.18</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt; - Half of RDF + 2 kg/plant of DE</td>
<td>1.18</td>
<td>0.37</td>
<td>16.06</td>
<td>124.71</td>
<td>0.30</td>
<td>218.50</td>
<td>33.48</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt; - Half of RDF + 3kg/plant of DE</td>
<td>1.07</td>
<td>0.33</td>
<td>15.83</td>
<td>121.15</td>
<td>0.33</td>
<td>232.40</td>
<td>53.33</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt; - RDF + 1 kg/plant of DE</td>
<td>1.22</td>
<td>0.36</td>
<td>16.20</td>
<td>113.78</td>
<td>0.29</td>
<td>239.76</td>
<td>61.48</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt; - RDF + 2 kg/plant of DE</td>
<td>1.20</td>
<td>0.41</td>
<td>15.70</td>
<td>110.56</td>
<td>0.28</td>
<td>240.87</td>
<td>62.86</td>
</tr>
<tr>
<td>T&lt;sub&gt;9&lt;/sub&gt; - RDF + 3 kg/plant of DE</td>
<td>1.39</td>
<td>0.44</td>
<td>17.55</td>
<td>136.58</td>
<td>0.45</td>
<td>260.53</td>
<td>67.45</td>
</tr>
<tr>
<td>S.Em±</td>
<td>0.04</td>
<td>0.02</td>
<td>0.53</td>
<td>0.03</td>
<td>2.10</td>
<td>6.45</td>
<td></td>
</tr>
<tr>
<td>CD @ 5%</td>
<td>0.10</td>
<td>0.06</td>
<td>1.59</td>
<td>N.S</td>
<td>0.10</td>
<td>6.31</td>
<td>19.35</td>
</tr>
</tbody>
</table>

N.S- Non significant
Micronutrients of guava leaves viz., Calcium, Magnesium, Zinc, manganese, and Copper, there was significant difference among the different treatments. The maximum calcium content (1.39 %) was observed in T₉ (RDF + 3 kg/plant of DE), which was followed by treatment T₇ (1.22 %), while minimum calcium content (0.86 %) was observed in T₁ and it was found on par with T₂ (0.94%). The maximum magnesium content (0.44%) was observed in T₉ (RDF + 3kg/plant of DE), while minimum magnesium content (0.28 %) was observed in T₁. In case of zinc content of guava leaf the maximum zinc content (17.55 ppm) was observed in T₉ (RDF + 3kg/plant of DE), which was on par with treatment T₇ (16.20ppm), and T₅ (16.06 ppm). While minimum zinc content (11.31ppm) was observed in T₁ which was found on par with T₂ (11.81ppm). The maximum copper content (67.45ppm) was observed in T₉ (RDF + 3kg/plant of DE), which was on par with treatment T₄ (65.18 ppm), T₈ (62.86ppm) and T₇ (61.48ppm) while minimum copper content (30.73ppm) was observed in T₂ which is found on par with T₅ (33.48ppm) and the Manganese content of leaves also found significant and the maximum content of manganese (260.53ppm) was noticed in treatment T₉ (RDF +3 kg/plant of DE), followed by T₈ (240.87ppm). While minimum manganese content (160.31 ppm) was observed in treatment T₁. This is due to silicon helps in more absorption of calcium, magnesium, zinc, manganese, and copper in to the plant tissue. Similar results were noticed by Lalithya et al., (2014) in sapota, Bhavya (2010) in Bangalore Blue grapes, Savvas et al., (2009) in tomato, Milne et al., (2012) in lettuce, Kamenidou et al., (2009) in gerbera and Mary (2005) in rose.

Iron content was found non significant difference among the different treatments with respect to iron content of leaf, however the maximum iron content (137.38 ppm) was observed in T₃ (RDF + 3 kg/plant of DE). While minimum iron content (110.56 ppm) was observed in T₈.

The maximum silicon content (0.45 ppm) was observed in T₉ (RDF + 3 kg/plant of DE), which was followed byT₆ (0.33 ppm) and T₄ (0.32 ppm). While minimum silicon content (0.20 ppm) was observed and it shows significant difference among the different treatments with respect to silicon content of leaf T₁. Application of higher dose of Diatomaceous Earth leads to more absorption on silicon by leaves of guava plants. The results are in conformity with findings of Lalithya et al., (2014) in sapota, Bhavya (2010) in Bangalore Blue grapes, Savvas et al., (2009) in tomato, Milne et al., (2012) in lettuce, Kamenidou et al., (2009) in gerbera and Mary (2005) in rose.

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